Thesis/
Reports
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Long-Range Fire Assessment

Northwest Geographic Area

1998 Fire Season

Final Report

National Interagency Fire Center
Boise, Idaho

August 1, 1998

Executive Summary

Early season precipitation has resulted in less than average large fire activity throughout the Pacific Northwest. These late spring rains contributed to abundant herbaceous growth, especially in the basins of eastern Oregon and Washington. These fuels will soon be fully cured throughout the Northwest. High pressure has moved back over the western United States resulting in hotter and drier conditions. These conditions are expected to persist through October. The increased herbaceous load, along with the expected warm, dry, windy fall sets the stage for an active, later than usual fire season.

Weather patterns across the Pacific Northwest were greatly influenced by El Nino during the 1998 winter and spring. Most of the Region experienced a mild winter with near to below normal snowpack. The only above normal snowpack occurred in south-central Oregon and north-central Washington.

A series of moist Pacific storm systems brought record setting rain and unseasonably cool temperatures to all of Oregon and eastern Washington in May. Rainfall amounts of 5-8 inches were common in western Oregon and 3-5 inches in eastern Oregon and eastern Washington. June was relatively dry but cooler than normal.

Ocean temperatures in the central equatorial Pacific became cooler than normal in July signaling the end of El Nino and the beginning stages of La Nina. La Nina is the opposite of El Nino and is characterized by unusually cold ocean temperatures in the equatorial Pacific. Long-range forecasts indicate this La Nina may be one of the stronger ones similar to the 1988-1989 La Nina.

The remainder of the summer should be little warmer and drier than normal. More than the usual dry lightning and strong wind events are also possible. Weather records from past La Ninas suggest this fall could be drier than normal with more than the usual number of East Wind events. The end of the fire season could be delayed until late October or early November. The long range outlook for the coming winter indicates very wet and cool conditions throughout the Pacific Northwest.

The team reviewed historical climate, fire danger, and fire occurrence data and developed three possible scenarios:

Best Case Scenario. A normal end to the fire season. Only minimal dry lightning occurrence along with a small number of east wind events later in the fall. Few fires escape initial attack. Suppression resource demands are met from with in the Geographic Area.

Intermediate Scenario. Fire season extends to mid-October. August warmer and drier than normal. Typical dry lightning and cold front events. Spotty light rain possible in September, but not significant. September and October remain warmer and drier than normal with occasional East Wind events. Expect many large fires that may require resources from outside the Region.

Worst Case Scenario. Very warm and dry through October with frequent dry lightning and East Wind episodes. Fire activity continues through early November, especially in SW Oregon. Numerous escaped fires, frequent large, high intensity, long duration fires resulting in competition for resources among Geographic Areas.

The most likely scenario for the remainder of the summer is the intermediate scenario, which implies an extended dry fall. The worst case has a higher probability of occurrence than the best case scenario.

Important factors affecting the outcome of the 1998 fire season in the Great Basin are:

- continued dry weather will result in curing of the bumper herbaceous crop, especially in east side preparedness zones,
- high elevation forests are not at critical moisture levels currently but may reach these levels with extended drying,
- large fuels will begin to contribute to fire growth,
- fire spread rates and intensity will increase potentially resulting in more large fires,
- problematic fire activity could persist for three to four weeks longer than normal,
- the La Nina weather phenomenon will dominate the weather through the fall and into the winter,
- fire season activity similar to 1987, 1994, or 1996 is possible, given the current conditions.

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Introduction

The demand for long-range fire assessments has been increasing during the last decade and increased needs for better information to support fire management decision-making will continue to grow (Mutch 1998). Long-range assessments varying in magnitude have been periodically completed since 1987 in numerous parts of the United States. These previous examples varied according to desired objectives and specific fire circumstances. Past assessments, although variable in nature, have focused on three principal areas: possible growth of escaped wildland fires, regional fire assessment, and long-duration wildland fire assessment.

Early in the 1998 wildland fire season the State of Florida experienced one of the worst fire seasons in history. Many large fire complexes burning in mixtures of wildland and developed areas resulted in over 450,000 acres burned and an estimated 370 structures damaged or destroyed. As resources were mobilized and assigned from throughout the United States to battle the Florida fires, questions arose regarding the severity of this situation, its potential duration, and continuing resource needs. To respond to these information needs, the National Multi-Agency Coordinating Group (MAC) at the National Interagency Fire Center (NIFC) in Boise established a Long-Range Fire Assessment Team. The team reviewed the fire potential, expectations of future activity, briefed local officials and wrote a formal report.

As time progressed the Florida situation moderated and interest became focused on evaluating and projecting the severity of the remainder of the fire season in the western United States. As a result, the National MAC directed that another team be assembled to assess potential fire conditions in three western geographical areas: Great Basin, Pacific Northwest, and Northern Rocky Mountains. This team initiated assessment activities on July 26, 1998 and conducted reviews in each of the three geographic areas. Formal reports were prepared as each area assessment was completed. This is the second in the series of the three geographic area assessment reports.

The fire potential situation in the Northwest warranted an assessment of the regional-scale fire situation. A region-wide assessment, such as the Northern Rockies 1994 Assessment (Bradshaw and Andrews 1998) presents a difficult challenge (Rothermel 1998). The area of concern is large in size and may include many fires. As a result, assessment of long-term risk, fire growth, and fire duration for individual fires does not provide information relative to all fires and circumstances. Often, a large number of individual fires also precludes detailed analysis for each fire. Furthermore, as in this case, an assessment may precede the onset of or have the objective of forecasting the likelihood of a severe fire situation. So, past experience in long-range fire assessment does not provide a process that fully addresses emerging needs for current and future fire assessments. This series of assessments was designed to focus on comparative differences among current and historical conditions for the geographic area of concern. Analytical techniques utilized included products of the National Fire Danger Rating System (NFDRS) (Deeming, Burgan, and Cohen 1977), review of climatological data, remote sensing of vegetation conditions by satellite, and computer models used by the National Weather Service to predict possible future weather patterns.

The objectives of the long-range fire assessment for the Northwest Area are:

- Review the overall severity of the wildland fire situation in the Northwest,

- Compare the on-going fire potential with historical situations,
- Evaluate the expected duration and assess the probability of season-slowing and season-ending events,
- Develop implications of the remainder of the fire season in the Northwest, based on projections of "best-case, intermediate, and worst-case" scenarios.

The team established to complete this assessment consisted of interagency specialists from various areas and having skills and experience in numerous types of fire assessments, projections, and evaluations.

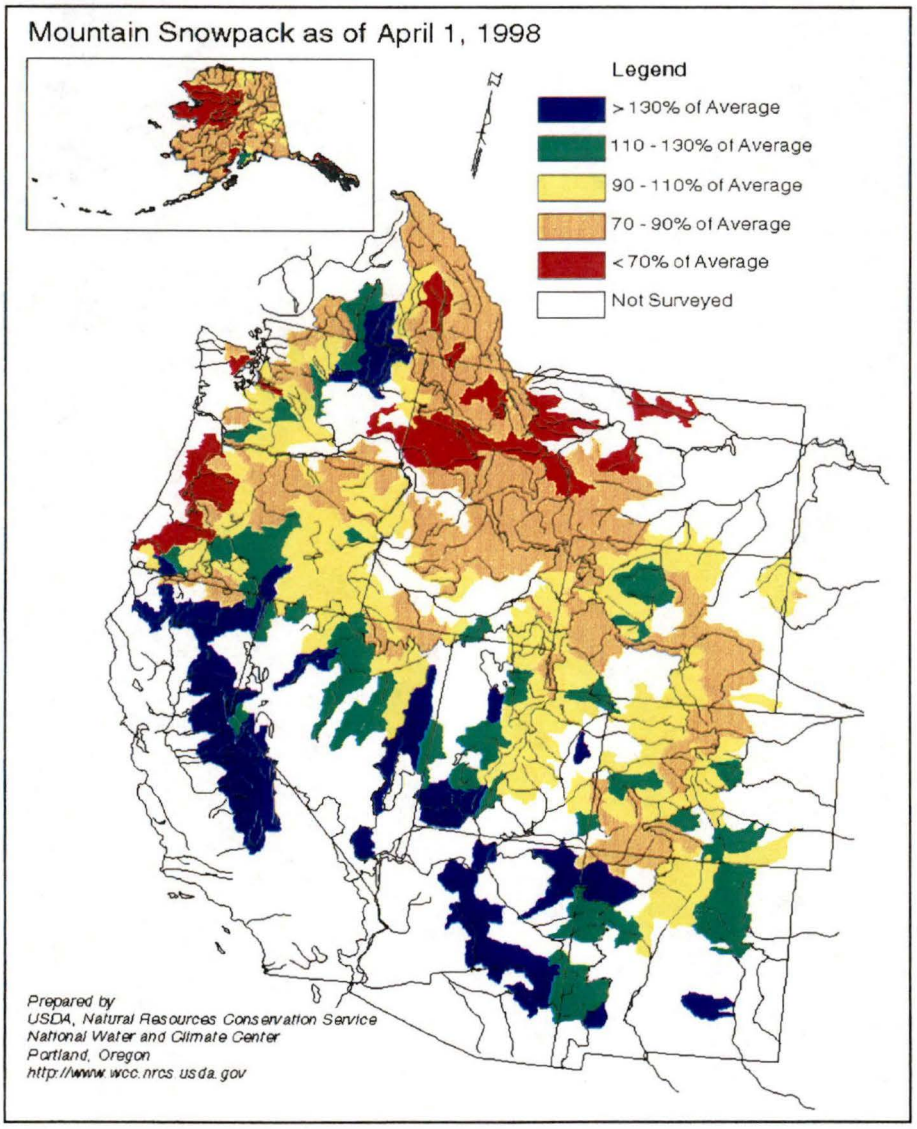
The assessment team consisted of the following individuals:

Mike Hilbruner	USFS - R-6	Team Leader
John Robertson	USFS - Umatilla NF	Fire Behavior Analyst
Pat Garbutt	USFS - Kaibab/Coconino NF	Prescribed Fire Behavior Analyst
Tom Wordell	USFS - Umatilla NF	Prescribed Fire Behavior Analyst
Lisa Elenz	NPS – Grand Teton NP	Fire Behavior Analyst
Roberta Bartlette	USFS - Intermountain Fire Sciences Lab (Missoula, MT)	Forester
Paul Werth	NWS – Boise, ID	Meteorologist
Larry Bradshaw	USFS - Intermountain Fire Sciences Lab (Missoula, MT)	Meteorologist

Current Situation

Weather:

Weather patterns across the Pacific Northwest were strongly influenced by El Nino in 1997 and 1998. El Nino is characterized by unusually warm ocean temperatures in the Equatorial Pacific from the date line eastward to the South American coast. It occurs in cycles ranging from two to seven years with marked differences in intensity and duration. This El Nino was comparable to the one of 1982-1983, perhaps the strongest event this century. This phenomena is linked to shifts in global precipitation patterns resulting in floods in arid areas and droughts in areas that are normally wet. Severe droughts and large wildland fires occurred in 1997 and 1998 in Australia, Indonesia, Central America and Africa. In North America, the impacts of El Nino are most dramatic during the winter. The jet stream becomes stronger and sags farther south over the southern United States.



Meanwhile, persistent high pressure becomes established over western Canada. The southern states from California to Florida typically experience cool, wet weather during the winter while the northern tier of states are drier and milder than normal. Winter precipitation in the Pacific Northwest reflected this pattern. Snow-packs the first of April were near or below normal (70 to 100 percent) across much of the region (Figure 1). The exceptions were portions of south-central Oregon and north-central Washington which had greater than 130 percent of normal.

Figure 1. Mountain snowpack as of April 1, 1998.

Fire Danger and Greenness Imagery:

Fire danger indices have varied throughout the area reflecting both weather and seasonal trends exhibited to date. In some areas the Energy Release Components for individual stations are well above average while others are below normal. Woody and herbaceous fuel moistures have also ranged dramatically, setting both maximum and minimum records in various areas. These fuel moistures have dropped dramatically in a very short time period. Satellite imagery shows that live fuel moistures have very quickly trended toward normal or below with the hot/dry weather. Some areas have trended below normal the entire season, reflecting the deficit in precipitation this winter and spring. Although the general zone maps in most areas are trending at normal individual stations should be monitored to ensure area specific indications of extreme fire potential aren't missed. The prediction of later than normal precipitation this fall and the chance of East Wind events could greatly affect these areas.

The condition of live vegetation can be assessed using the Normalized Difference Vegetation Index (NDVI), calculated from satellite observations at a 1 kilometer resolution. The NDVI relates to the amount of actively photosynthesizing biomass, or vegetation "greenness", and can be interpreted to assess relative fire danger (Burgan and Hartford 1993). The greenness data are displayed as maps. Two maps useful for interpreting vegetation condition to fire potential relate the NDVI of each kilometer to its own historical record. Relative Greenness maps represent how green the vegetation is compared to the range of values observed since 1989 when this data became available. They are useful for showing seasonality vegetation change and for comparing years. Departure from Average maps display differences between current and average greenness for that time of year.

During the spring and early summer, much of the forested areas of the Pacific Northwest reached near or over 100% of the maximum greenness recorded during the period of history. Eastern Washington basins and river valleys reached 50 to 80% of maximum greenness, which may represent average vegetation growth for the area. The majority of the Pacific Northwest Region ranged from 125% to 200% of average greenness during the months of June and July. The Departure from Average map from composite period ending 07/23/98 (Figure 2) illustrates the extent of above average greenness for early and mid summer. The foothills east of the Cascades, and particularly the southeastern quarter of Oregon have reached and maintained very high greenness values this year. Attaining very high Relative Greenness values and maintaining values that are higher than average for much of the greenup period indicates a greater than average load of vegetation has grown. When cured, this vegetation results in greater than normal fine fuel loads.

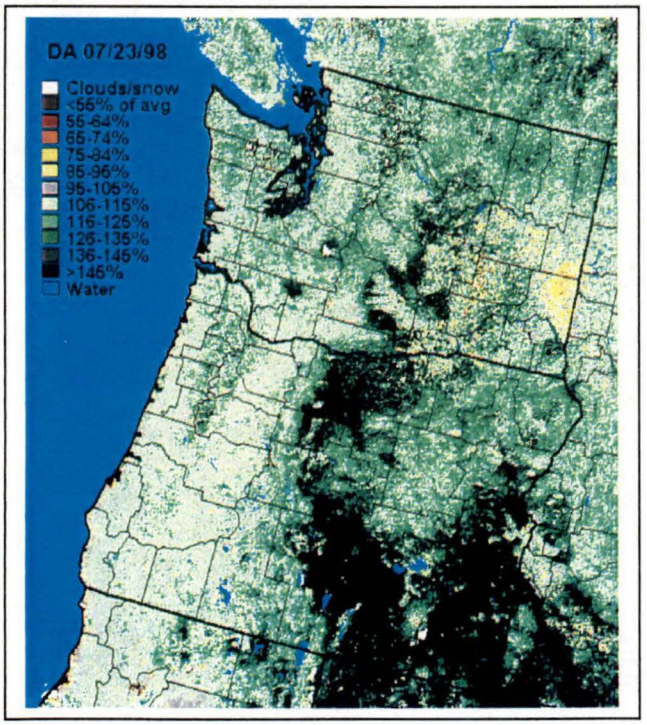


Figure 2. Departure from average - 7/23/98.

Comparisons of the current Relative Greenness map for 07/30/98 and maps from the same time period during 1996 (Figure 3), show far more extensive curing in southeastern Oregon during 1996 but striking similarity to 1996 in Washington.

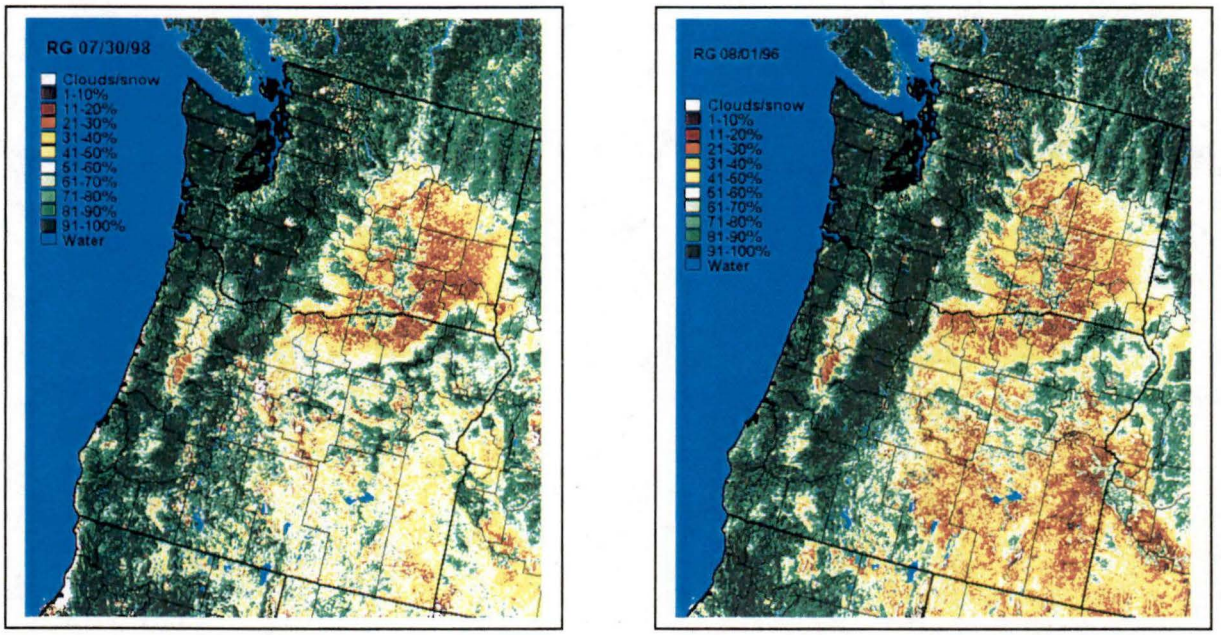


Figure 3. Northwest Area relative greenness comparison between July 1998 (left) and July 1996 (right).

The state of the vegetation in Washington is similar to that in 1996 with two notable exceptions. These are best displayed by looking at a difference map created by subtracting the 1996 Relative Greenness map for this time period from the current map (Figure 4). Gray indicates similar conditions between the two years. Green areas, such as the strip from The Dalles on the Columbia River north to the Canada border show much more growth and/or a much more green condition over that of 1996. An area ranging from Pendleton, OR through the Spokane area and extending northward into Canada indicates relatively dry conditions. Although this area has abundant grass that remained green until late June, it cured rapidly and is now drier than 1996. The Oregon coastal and Cascade areas have similar conditions to 1996, however, vegetation remains much more green and extensive in the eastern two-thirds of the state.

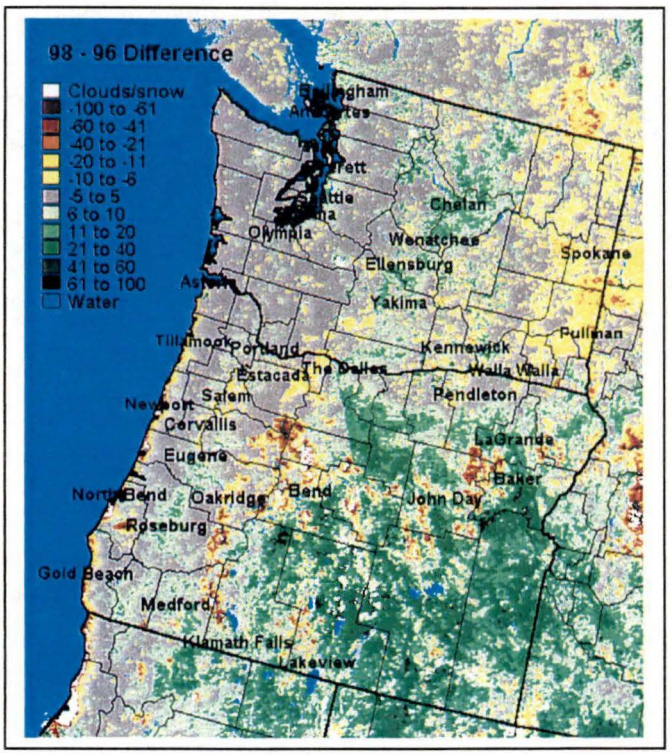


Figure 4. Relative greenness difference.

All zones contain areas that have cured extensively as shown by the difference map created by subtracting the Relative Greenness map dated 07/23/98 from the map dated 07/30/98 (Figure 5).

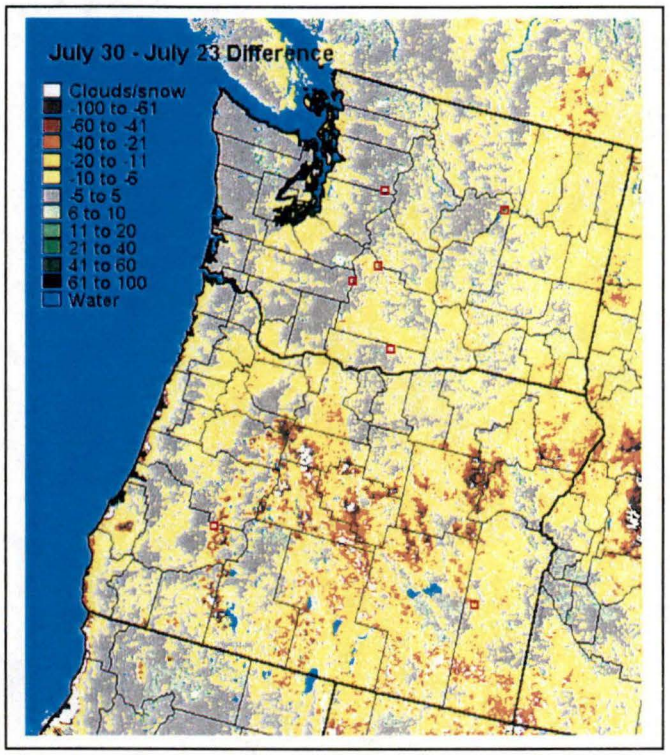


Figure 5. Difference in relative greenness between 7/23/98 and 7/30/98.

Areas that have cured over the past week are shown in yellow through brown tones. Gray areas indicate little change from last week. Most areas remain well above average greenness for this time of year, however the normal condition for this time of year for most herbaceous plants is matured or curing.

In general, vegetation in upper elevation forested areas, while currently remaining green compared to rangelands, are approaching normal greenness for this time of year and have reached conditions similar to 1996. Curing should be expected to continue throughout forest and basin areas due to the normal plant phenological progression. Portions of eastern Washington, particularly in the area from Pullman, broadening through Spokane and north to Canada appear to have been under a much drier regime than the balance of the Region and are now cured. As the inevitable curing progresses in August, much of eastern Oregon will have a higher load of fine fuels than in average years.

Comparison of Current and Historical Weather and Fire Activity

Weather:

During the spring, ocean temperatures in the Equatorial Pacific rapidly returned to more normal levels signaling an end to the current El Nino episode. As a result, the strong jet stream that pushed storms across southern California and the Southwestern States during the winter shifted north. Pacific storms were now directed more toward northern California and southern Oregon.

Precipitation patterns during the spring reflect this storm track with heavier than normal rainfall extending across southern and eastern Oregon into far eastern Washington. Western Washington, the Oregon coast and the western slopes of the northern Oregon Cascades were all drier than normal. A selection of weather stations is presented below in Tables (1-2) which illustrate the monthly precipitation and departure from normal for both Washington and Oregon.

Table 1. Washington precipitation and departure from normal (April through July).

LOCATION	April	Dep	May	Dep	June	Dep	July	Dep
Quillayute	3.15	-4.36	3.61	-1.79	1.50	-1.62	1.45	-1.12
Olympia	1.21	-2.08	0.83	-1.26	1.29	- 0.34	0.18	-0.64
Stampede Pass	2,67	-3.65	4.62	+0.37	3.01	-0.48	0.51	-1.51
Wenatchee	0.56	-0.06	2.15	+1.62	0.56	-0.01	0.56	-0.32
Spokane	0.89	-0.29	3.09	+1.68	0.84	- 0.42	0.37	-0.30

Table 2. Oregon precipitation and departure from normal (April through July).

LOCATION	April	Dep	May	Dep	June	Dep	July	Dep
Portland	1.04	-1.35	5.55	+ 3.49	1.73	-0.25	0.59	-0.04
Eugene	2.61	-0.50	4.99	+2.83	0.79	-0.64	Trace	-0.51
Medford	2,25	+1.09	4.26	+3.26	0.67	+ 0.09	0.00	-0.26
Redmond	0.55	-0.03	1.69	+0.98	0.20	-0.53	0.03	-0.42
Klamath Falls	0.35	-0.44	3.57	+2.88	1.04	+0.47	0.01	-0.42
Baker City	0.79	-0.03	4.35	+3.09	0.60	-0.78	0.31	-0.27
Burns	1.03	+0.18	2.62	+1.50	0.73	+ 0.00	0.32	-0.08

April was drier and milder than normal for most of the region. The only exceptions were portions of southwestern and southeastern Oregon which were a little wetter than usual. Western Washington was well below normal receiving less than 50 percent of the usual rain amounts. Record high temperatures were recorded in some locations the latter part of the month when readings jumped into the 80s.

A series of moist Pacific storm systems brought record setting rains and unseasonably cool temperatures to all of Oregon and eastern Washington during the month of May. Rainfall amounts of 5-8 inches were common in western Oregon and 3-5 inches in eastern Oregon and eastern Washington. The storms mostly missed western Washington, thus rainfall totals there remained well below normal. June was relatively dry and cool. However, portions of southern Oregon continued to be wetter than normal. Figure 6 is a graphical representation of the percent of normal precipitation from April through June. The Oregon coast, Western Washington and the Washington Cascades all received between 70-90% of normal rainfall during the spring. The Willamette valley in Oregon and the Columbia basin in Washington were both near normal. Southern/eastern Oregon and eastern Washington received 130-190% of their usual rain.

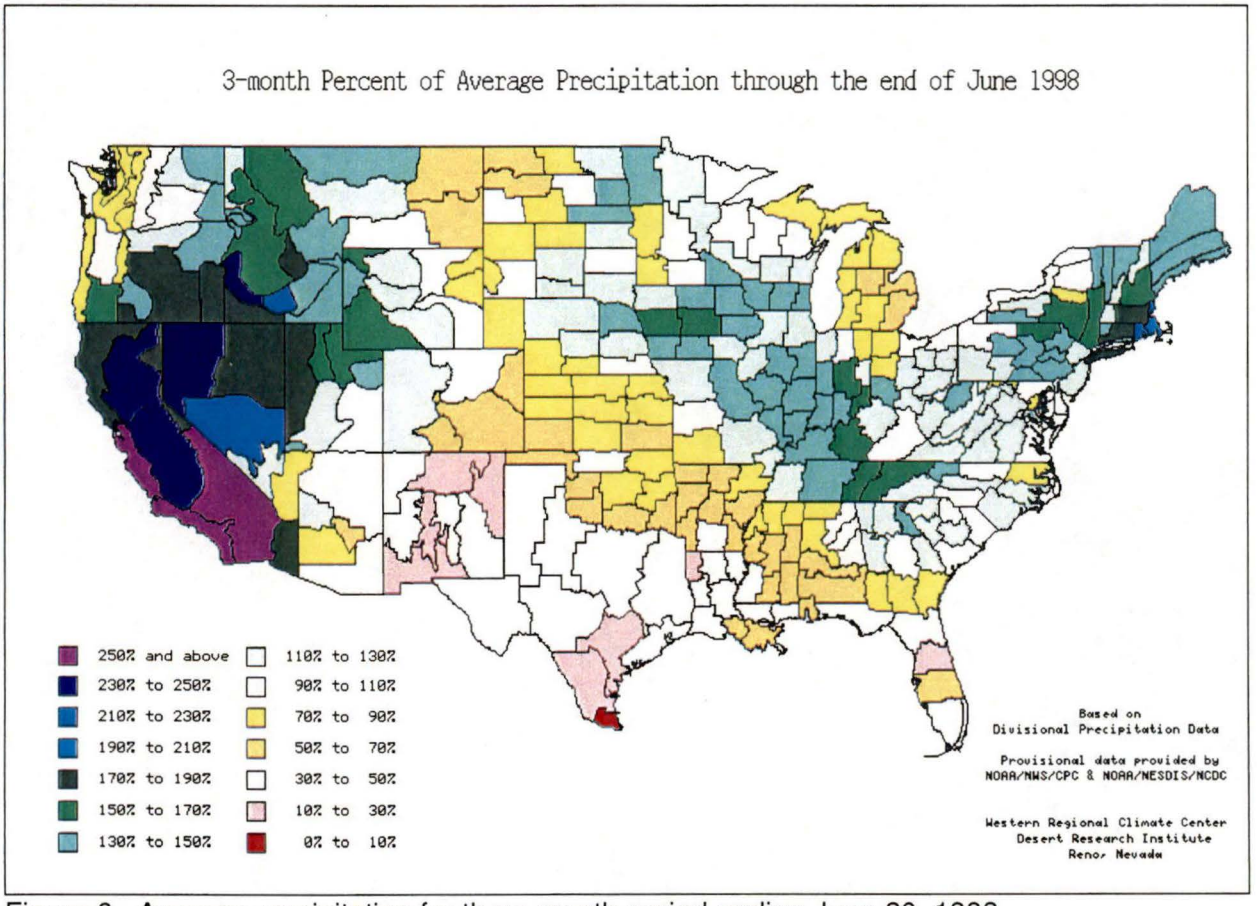


Figure 6. Average precipitation for three-month period ending June 30, 1998.

Ocean temperatures in the central equatorial Pacific became cooler than normal in July signaling the end of El Nino and the beginning stages of La Nina. La Nina is the opposite of El Nino and is characterized by unusually cold ocean temperatures in the equatorial Pacific (Figure 7).

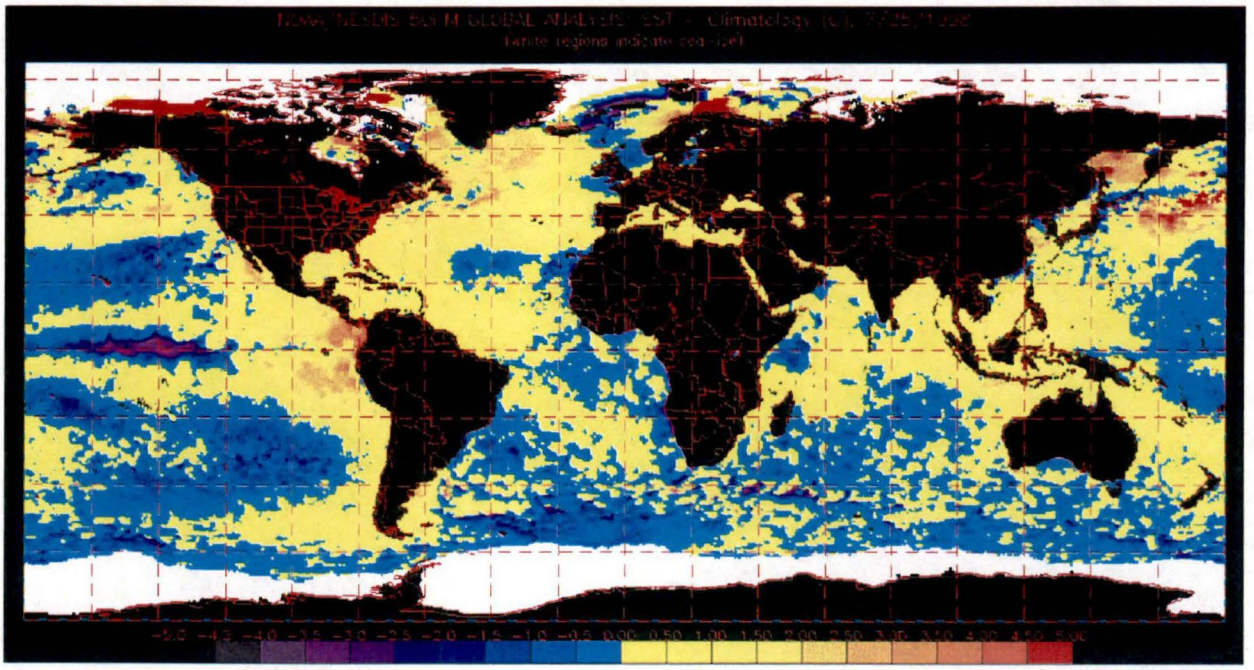


Figure 7. Ocean temperatures July 25, 1998 compared to normal.

La Nina often follows El Nino, but not always. In the last 50 years, there have only been 10 La Nina cases, the most recent in 1988-89. Global climate variations in La Nina tend to be opposite those of El Nino with weaker winter-time jet streams over the central and eastern Pacific, and enhanced monsoons over Australia/Southeast Asia, south/Central America and Africa.

The change to cooler ocean temperatures in the central Pacific probably had little affect on the Pacific Northwest's weather during July even though there was a marked change in the weather pattern. Strong high pressure aloft, which had persisted over Texas and the Southeastern States, shifted into the western states in July. Hot, dry weather developed throughout the Region around the middle of the month pushing temperatures well into the 90s. A real hot spell developed the last week of the month. Many lower elevation stations broke 100° F setting new daily record high temperatures. The Dalles reached 112° F, Pendleton 107° F, Medford 106°F, and Wenatchee and Eugene 105° F. An upper trough of low pressure moved inland the last of the month producing scattered thunderstorms. These thunderstorms were initially dry resulting in numerous fire starts. However, rain eventually accompanied most of the storms. Most of the month's rainfall resulted from thunderstorms that dotted the state early and late in the month. Rainfall amounts were generally below normal with some stations receiving none or just a trace. However, locally heavy downpours with thunderstorms occurred in portions of northeast and central Oregon. La Grande received 2.58 inches and Redmond 1.70 inches. It was much warmer than usual with temperatures averaging as much as 5° F above normal.

The August 1, 1998 Palmer Drought Index (Figure 8) definitely reflected the precipitation patterns during the spring and early summer. Moderate to severe drought was indicated for much of western Washington including the Cascades and the Columbia Basin. Portions of southeast and south central Oregon where still classified as moist. Most of the remainder of Oregon was near normal.

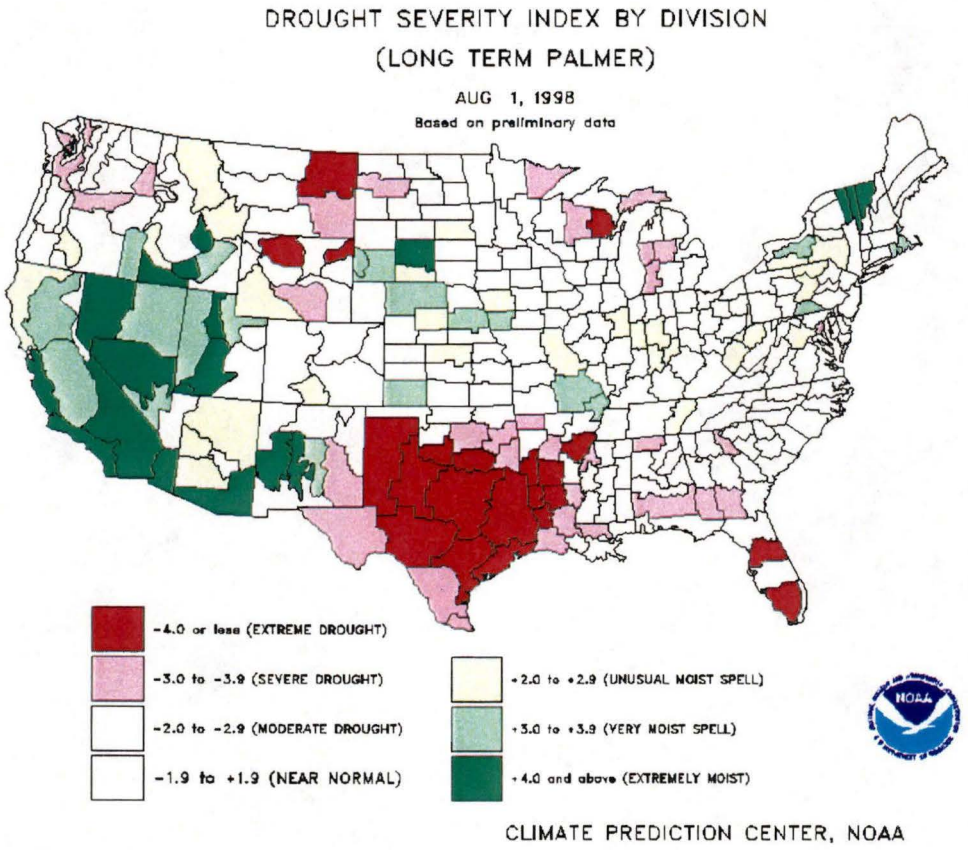

DROUGHT SEVERITY INDEX BY DIVISION
(LONG TERM PALMER)
AUG 1, 1998
Based on preliminary data
-4.0 or less (EXTREME DROUGHT)
-3.0 to -3.9 (SEVERE DROUGHT)
-2.0 to -2.9 (MODERATE DROUGHT)
-1.9 to +1.9 (NEAR NORMAL)
+2.0 to +2.9 (UNUSUAL MOIST SPELL)
+3.0 to +3.9 (VERY MOIST SPELL)
+4.0 and above (EXTREMELY MOIST)
CLIMATE PREDICTION CENTER, NOAA

Figure 8. Palmer Drought Index, August 1, 1998.

Fire Ignitions:

Large Fire History:

The 1998 fire season in the Pacific Northwest started slowly compared to the average fire season. Recent hot dry weather has rapidly accelerated fuel drying and curing. At the end of July, the geographic area had experienced 13 large fires (100 acres or larger) on federally managed lands, 3 large fires on state protected land and one on Department of Energy (DOE) land. Figure 9 displays the monthly average

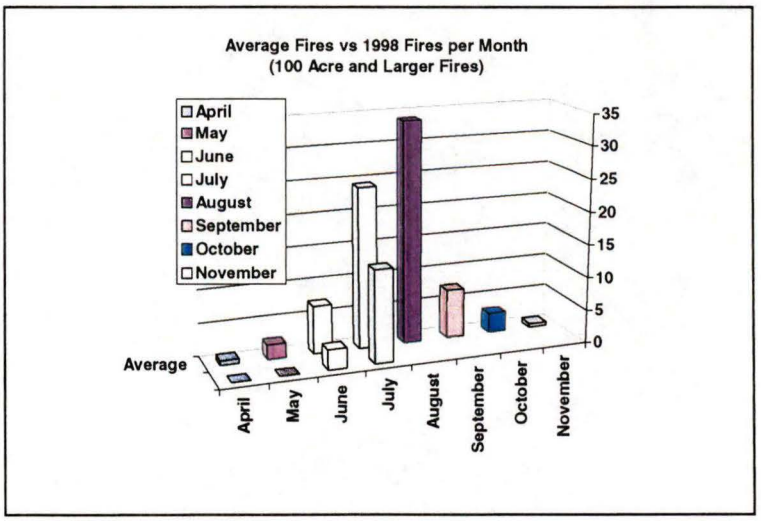


Figure 9. Average fires vs. 1988 fire by month.

large fire load as compared to this year for all federal agencies, excluding the DOE. The fire load in the geographic area is about 50% below the historical average. If this trend continues, the peak can be expected in August with 20 to 25 additional large fires on federally protected lands. Five or less large fires would be expected in September and October.

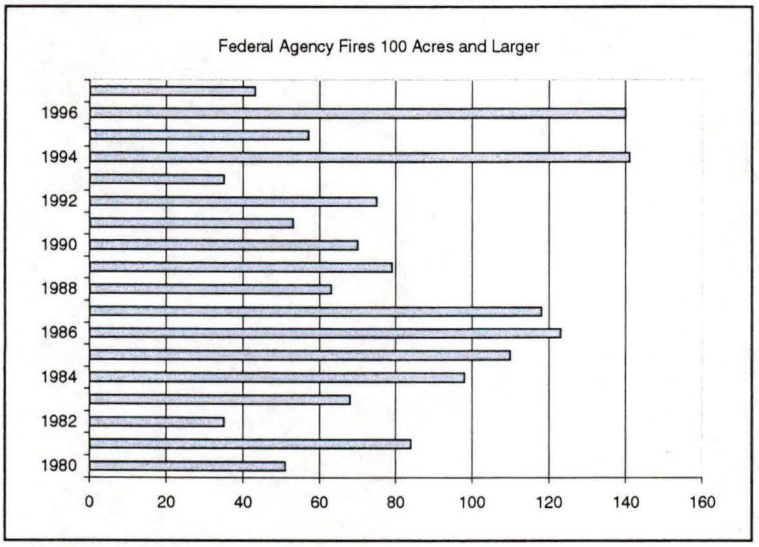


Figure 10. Federal agency fires 100 acres and larger.

Figure 10 displays large fires (100+ acres) for the USDA Forest Service (FS), and USDI Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Fish and Wildlife Service (FWS), and National Park Service (NPS) for the years 1980 through 1997. The years 1986, 1987, 1994, and 1996 stand out as severe fire seasons in this combined data set. The year 1988 represents average large fire occurrence.

Large Fires by Agency

On average, the FS can expect 24 large fires per year, BLM can expect 46, NPS can expect 2, and BIA and FWS can each expect 4 large fires per year. Figure 11 displays the large fire load for the NPS, FWS and the BIA for the years 1980 through 1997 illustrating the variation that occurs across agencies. For example, 1981 was a busy year for the NPS while 1988 was the busiest for the FWS and 1994 for the BIA.

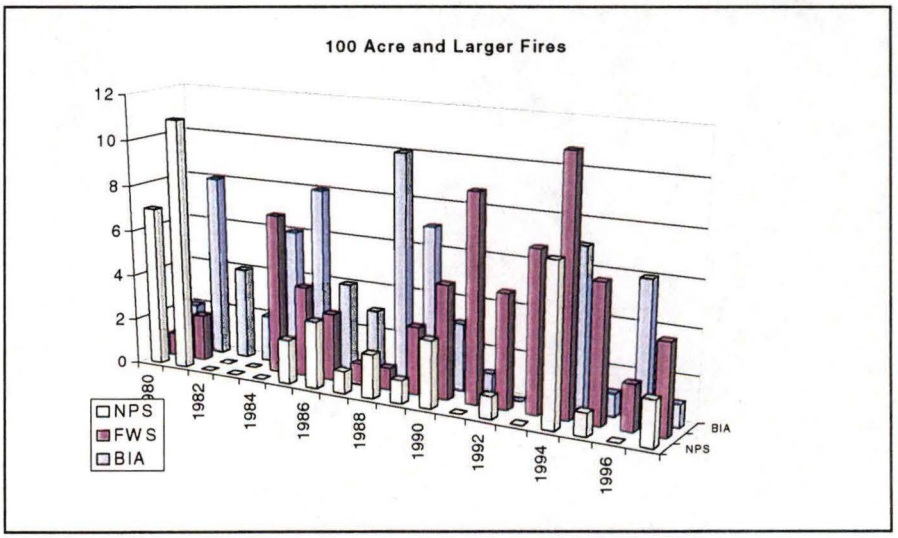


Figure 11. NPS, FWS, and BIA 100 acre and larger fires.

While 1996 was an active fire season overall, it was not as active on these agency lands as in 1994.

Figure 12 displays the total late season fire load for all federal agencies and can be used to define likely and worst case scenarios. Most of the large fires occur in August and September with a few in October and November. In a worst case situation, like 1996, an increased fire load in August can be expected. Seven of the 18 years the geographic area

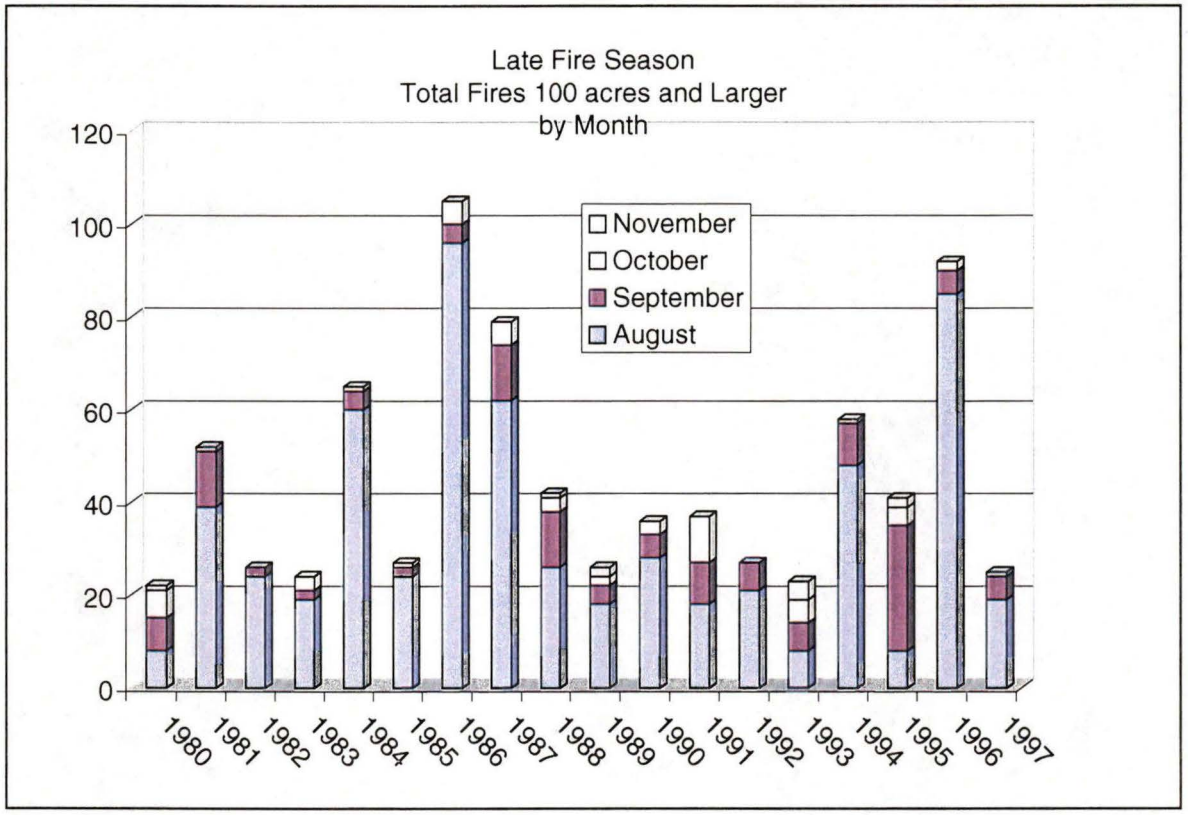


Figure 12. Late season fires 100 acres and larger.

has experienced 20 to 25 late August through November large fires. In two of the years (1980 and 1993) the fire season extended into November.

Fire Danger Indicators:

The Pacific Northwest Geographic Area has a plan in place which divides the area into preparedness zones (Figure 9) to facilitate timely recognition of approaching critical fire situations. Within each zone weather stations are monitored, given weighted values and averaged for comparison to history. See map below for a list of the zones and stations currently used.

For this analysis, individual stations were analyzed to ensure details weren't missed during the averaging process. The graphs in the following pages reflect particular stations and indices we felt warranted noting or watching in the future. These stations were selected for the preparedness zones based upon historic data, discussions with area managers and fire weather forecasters, representative elevations and fuel models.

The stations used for this comparison were processed using a representative fuel model to calculate the National Fire Danger Rating System (NFDRS) index values. The graphs on the following pages show this year's values and compare it to historic maximum, minimum, average, and one selected extreme year.

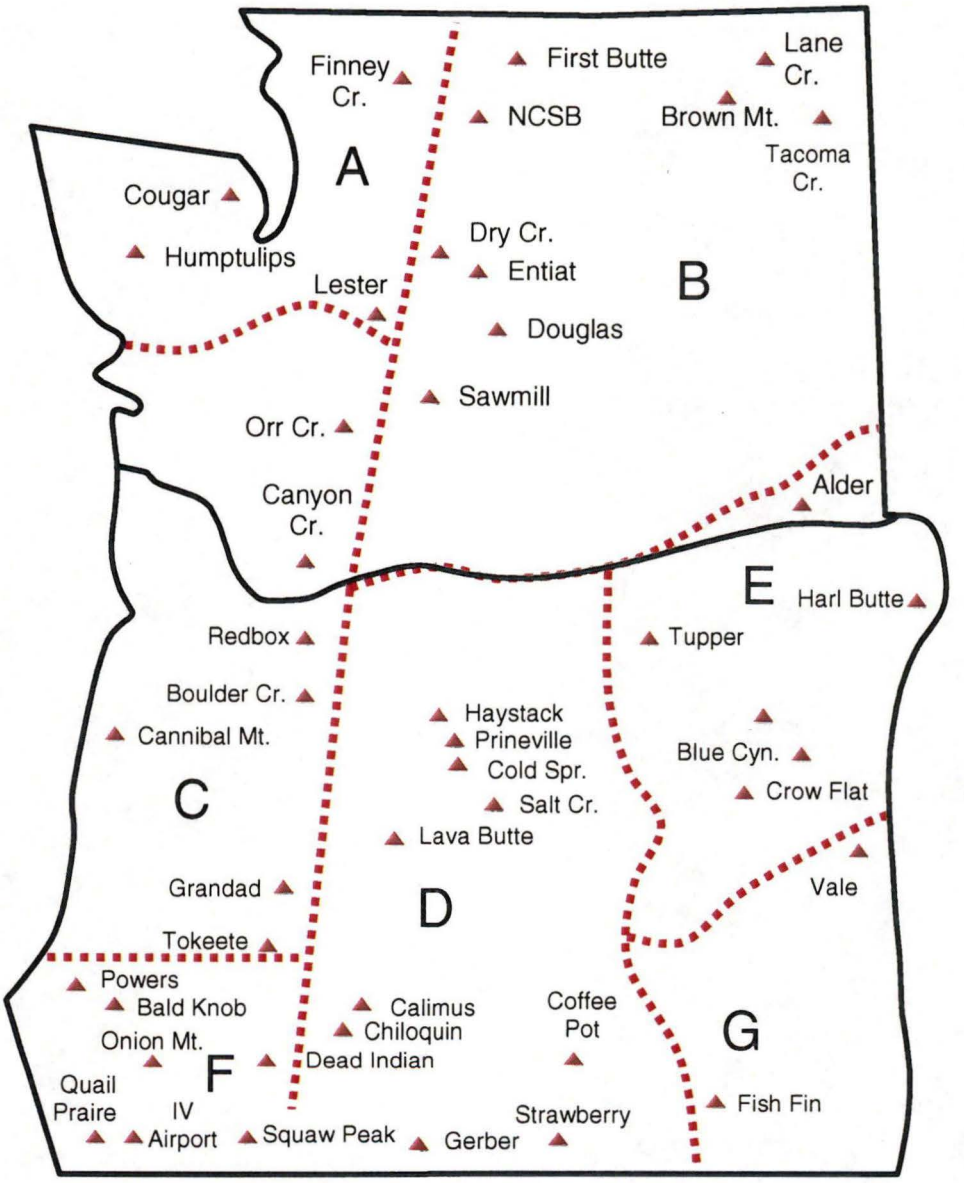
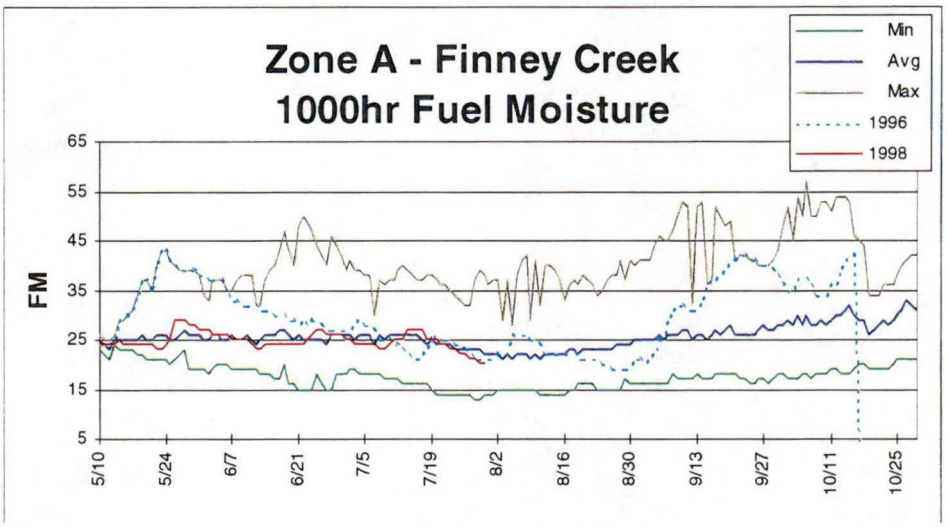


Figure 13. Pacific Northwest preparedness zones.

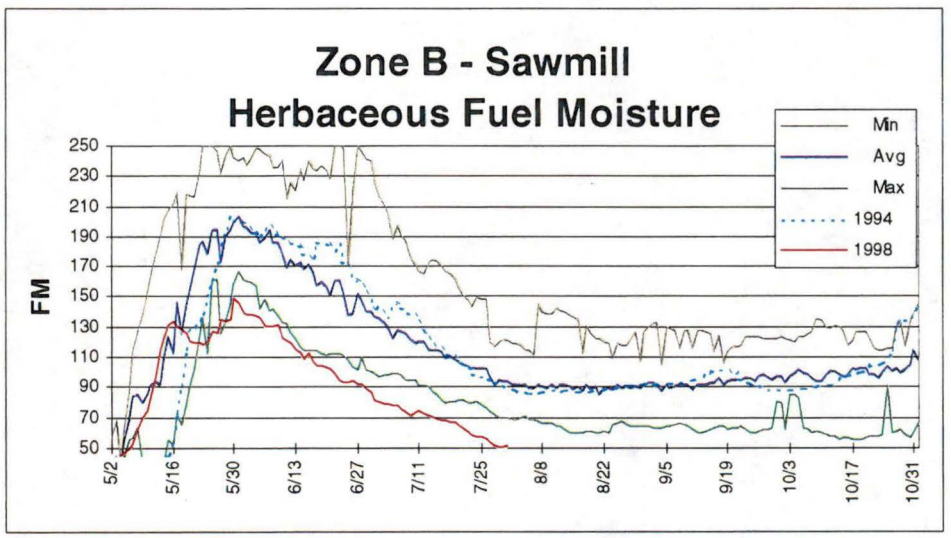
Zone A; Northwestern Washington - Fuel Model G

Woody, 1000 hour, and herbaceous fuel moistures are trending below average while Energy Release Component (ERC) values are trending upward. Of note, herbaceous fuels are curing through typical seasonal changes and therefore moistures are dropping. Lower elevations are heading into severe drought as evidenced by the Palmer Drought Index.

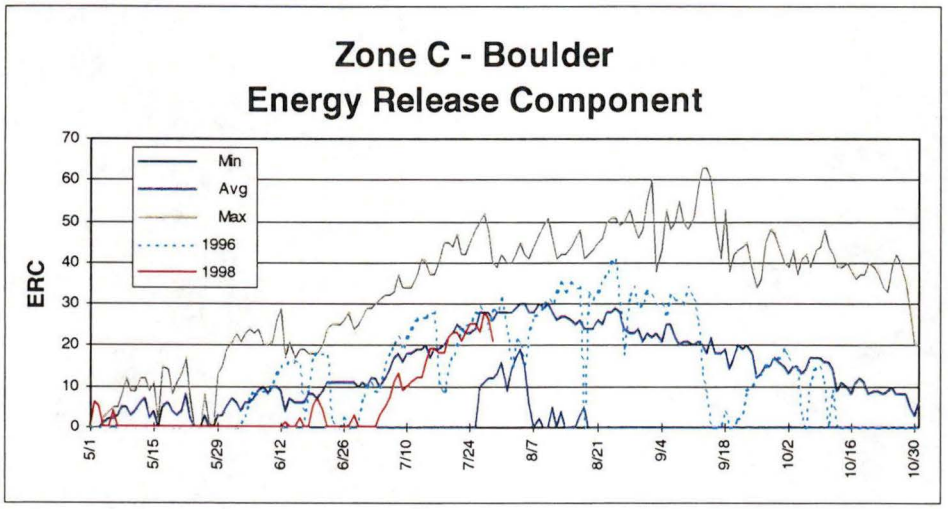


Zone B; Eastern Washington - Fuel Model C

This zone should be watched closely as the season progresses. Precipitation was minimal during April, June, and July. May was the only wet month providing recent precipitation to the Zone. Fuel moistures are lower than average and herbaceous is running at historical minimums. Greater than three-inch fuels were completely consumed during spring prescribed burning in this Zone indicating potential for large fire movement later in the season. The Palmer Drought Index is moving toward extreme drought. The Zone graph completed by the region also shows ERC values to be above average and the 1000 hour fuel moistures to be low.

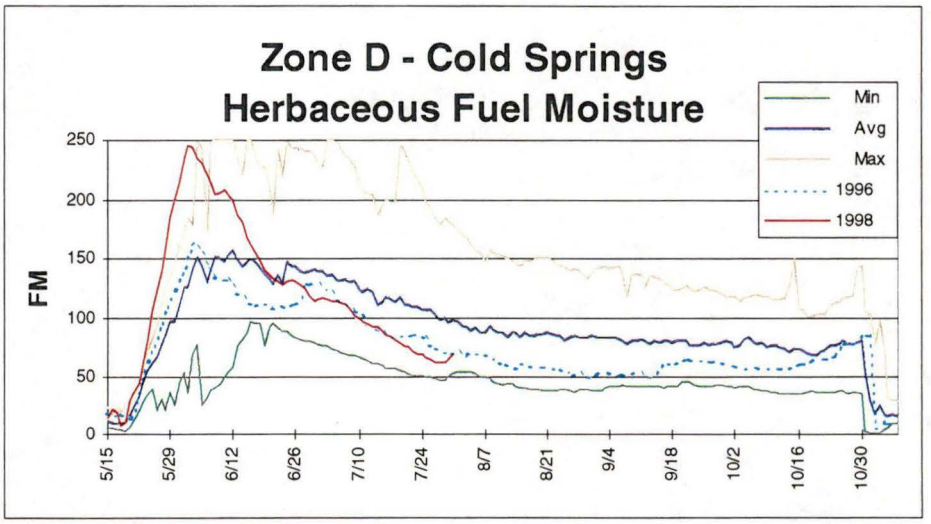


Zone C; Western Oregon, Southwestern Washington - Fuel Model G



Within this Zone, ERC values, woody and herbaceous fuel moistures are all running at average or a little above for all of the stations analyzed. Although the indices of this Zone are average, continued monitoring of individual weather stations into the fall is recommended.

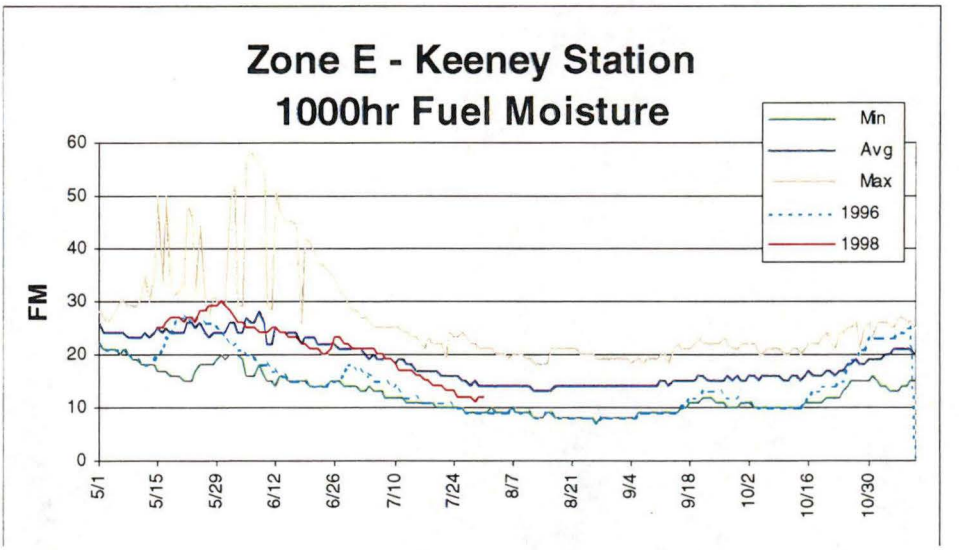
Zone D; Central Oregon - Fuel Model C



Recent rainfall has been heavier in the southern portion of this zone than in the north. The extreme northern end of this Zone is heading toward severe drought. The Zone ERC is tracking below average, however, individual weather stations reveal that herbaceous fuel moistures are approaching historical minimums and woody fuel moistures are in a downward trend. Vegetation life cycles will continue to cause woody and herbaceous fuel moistures to decrease. The onset of a La Nina event could stall further precipitation until late fall which may cause continued decrease in fuel moistures.

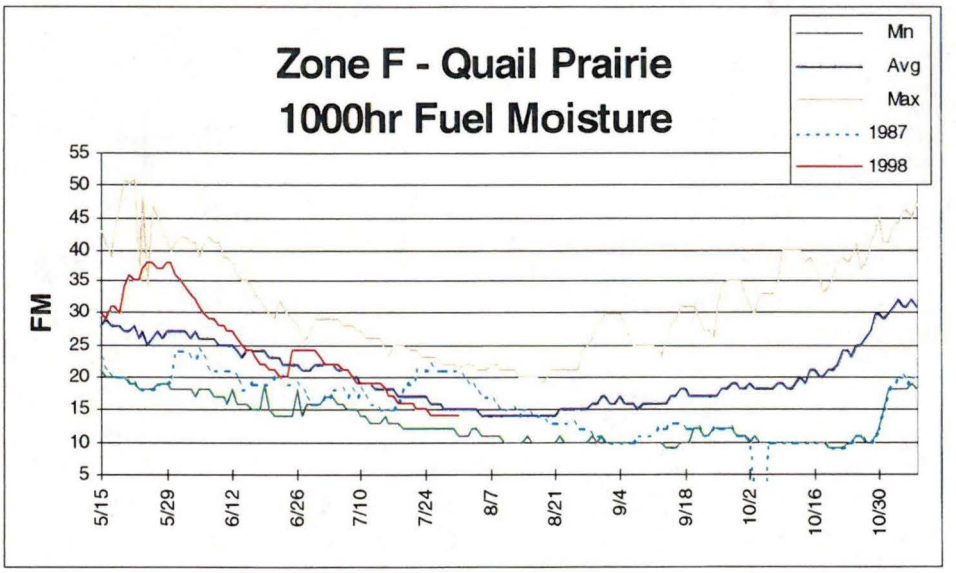
Zone E; Northeast Oregon - Fuel Model C

Although the Zone ERC graph is only a bit above normal, representative stations show decreasing fuel moistures making continued monitoring of this Zone desirable. The Palmer Drought Index is normal but heading downward revealing a drying trend. Fuel moistures will respond with continued drying.



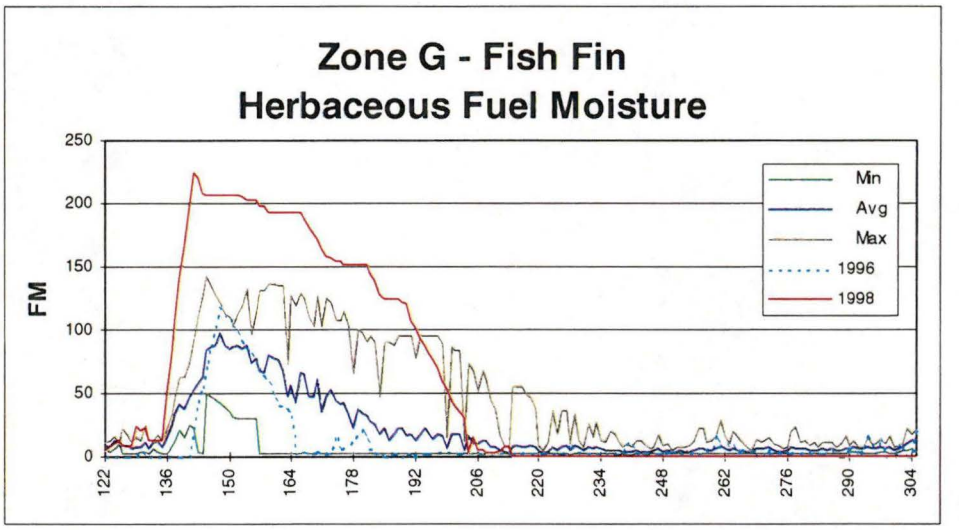
Zone F; Southwest Oregon - Fuel Model G

This Zone is historically busy later in the summer and stays drier longer. Although the Zone came into the fire season wet, many indices have dropped to average. Specifically, the 1000 hour and ERC indices are beginning to reflect drier conditions. If these trends continue, this Zone would experience a late and busy fire season.



Zone G; Southeast Oregon - Fuel Model T

The fuel moistures in this Zone were at record breaking maximums and have since dropped to average. Fuel moistures will continue to drop until significant precipitation is received. ERC values for the Zone are average. Increased fine fuel loading exacerbated by continued drying could promote large fires.



Fuels and Fire Behavior:

Curing of fine fuels east of the Cascade Mountains has been delayed due to early season rain. However, extremely hot, dry conditions have caused rapid curing in recent weeks, especially in the basins of eastern Washington. The continuity and increased amount of fine fuel has been identified as a critical factor affecting spread and intensity of fires this year. Thunderstorm downdrafts appear to have been the primary driver in several of the larger fires, but winds in general have not been a significant cause of large fire growth to this point in the fire season.

Fuel Description and Applicable Fuel Models:

The Pacific Northwest fuel complexes are generally divided by the Cascade Mountains and by elevation. Along the Oregon coast, a narrow band of lodgepole pine quickly transitions into mixed conifer stands of Douglas-fir, sitka spruce, western hemlock and western red cedar. Along the northern coast, Douglas-fir is the principal species and transitions to the wetter site species. On the west side of the Oregon Cascades, the valleys are generally grass and brush with stands of oak. As elevation increases, mixed conifer stands composed of Douglas-fir, hemlock, western red cedar and true firs then mountain hemlock and subalpine fir make up the overstory. Lodgepole pine stands occur along the crest and the higher elevation cold dry sites on the east side of the Oregon Cascades. On warmer east side sites, white fir (grand fir) makes up a large component of the mixed conifer stands in association with Douglas-fir, ponderosa pine and western larch. On the west side of the Cascades in Washington, western hemlock, Douglas-fir, Incense and western red cedar, and associated broadleaf shrubs cover the landscape as closed canopy forests, except in logged areas.

Vegetation in the eastern part of the area follows an elevational gradient. At low to mid elevations ponderosa pine dominates with minor amounts of Douglas-fir. In some locations Douglas-fir or ponderosa pine exist in almost pure stands. Grass and shrubs occupy the lower elevations with bitterbrush in association with the pine in many areas. Sage and grass make up much of the high desert of eastern Oregon and the interior Columbia River Basin in eastern Washington.

The wet spring has left a bumper crop of cheatgrass and an above average crop of perennial grasses. In southeastern Oregon, transects revealed up to 2.66 tons of grass in some plots. This is estimated to be 2 to 3 times the normal amount. In the mountains, local wind and snow damage has increased fuel loading particularly of fine fuels. In mid-elevations of the Cascades that are typically classified as Fire Behavior Prediction System (FBPS) fuel model 8 or 10 are now best represented by a slash model due to snow damage, blowdown and insect and disease problems.

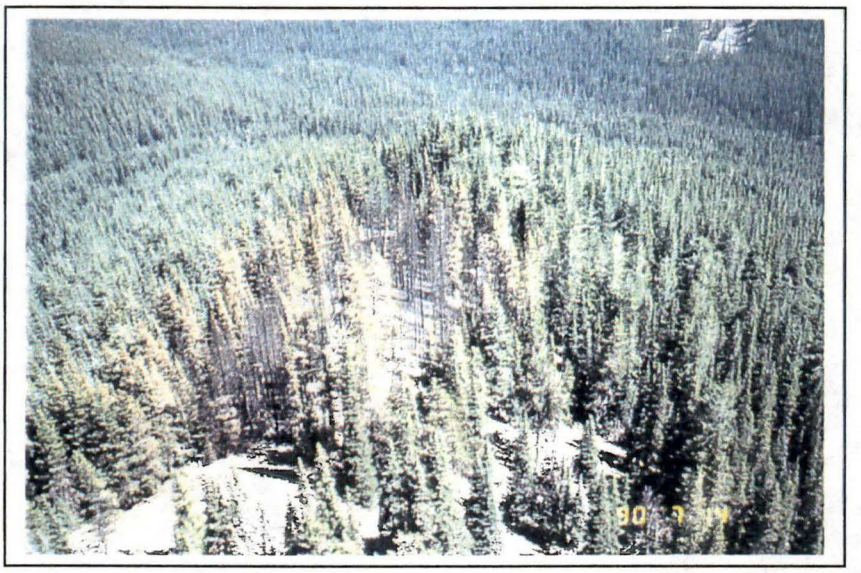
For the most part, the mixed conifer stands are represented by fuel model 10 (old growth) or 8 (younger stands). The ponderosa stands can be modeled with either a FBPS model 9 (no grass) or FBPS model 2 with a grass understory. Lodgepole pine can be modeled by a FBPS fuel model 8. Grasses generally fit into a FBPS model 1 and where exceptionally heavy FBPS model 3 (this also represents domestic crops of wheat barley, and oats). Brush is generally modeled as a FBPS 5 or FBPS 6 depending on live moistures and depth. A FBPS model 4 can be used to represent older brush fields in southern Oregon.

Fuel Moisture:

Grasses have generally cured in the lower elevations, particularly in the south and are just entering the cured state in the north. In northeastern Oregon, grasses are carrying fire up to about 4500 feet in elevation. In southern Oregon, grasses are carrying fire up to 6500 feet. At higher elevations, they are restricting fire spread. Recent hot weather has greatly accelerated drying across the region.

Fuel moisture sampling across Oregon and Washington varies in frequency and sampling methods making comparisons between actual measured values difficult. Sagebrush live fuel moisture is running about 12% below historical averages in southeastern Oregon, ranging from 110% in rangelands to near 135% in forests. The critical live fuel moisture in sage is 100%, below which sage actively burns.

1998 Fire Season Activity:



In July numerous small fires and several large fires occurred along the Cascade Crest. Most were started by dry lightning and pushed by thunderstorm related winds through the crowns and lichen (old mans beard). These fires typically consume all or the upper portion of the crown with little or no surface fire due to high herbaceous fuel moisture levels. One fire at 5200 feet burned about 230 acres in a one and one half-hour period with estimated rates of spread of 80 to 100 chains per hour due to thunderstorm outflow wind. These types of fires were observed in both Washington and in Oregon. These fires have not been indicators of an unusual season in the past.

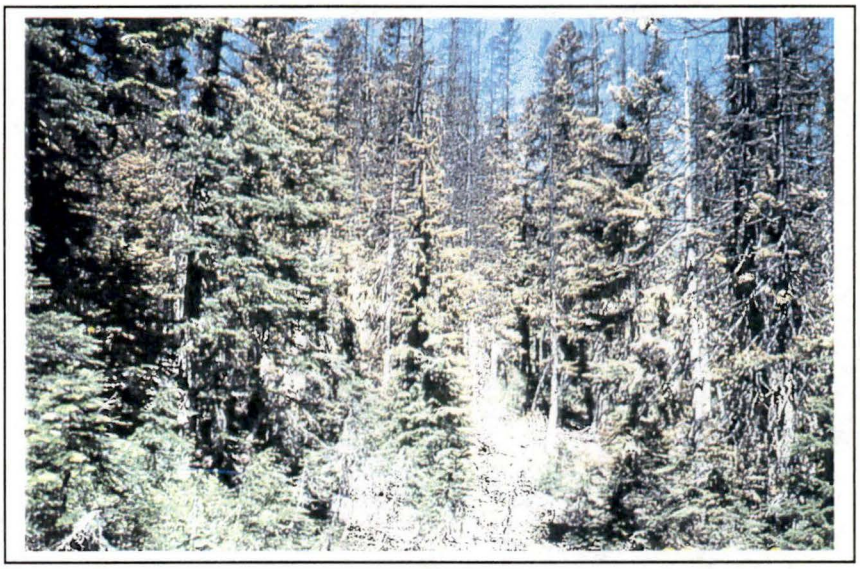
There is a significant potential of large range fires in southeastern Oregon this year. Abnormally high fine fuel loading resulted in one 1,900 acre fire. This is an example of a fuel driven situation as opposed to wind driven. Once the woody fuel moisture drops below 100%, ignitions occurring with high winds (cold front passage) and little if any rain have a potential for very large growth.

A fire north of the Columbia River in Washington consumed over 18,000 acres along with numerous homes and structures. This fire occurred in an area that has a historic fire return interval of 10 to 15 years but has not been burned since 1930's or 1940's. Spring moisture generated grass fuels nearly 10" high and greater than normal load resulting in more uniform and continuous fuel. Spread rates up to 350 chains per hour were estimated in grass under the influence of thunderstorm downdrafts. Fire was pushed into decadent pine stands. Fire behavior did include active crown fire supported by surface fire movement. It

can be speculated that foliar moisture contents were high enough to limit sustained crowning activity. There were also areas where grazing or discontinuous fuels provided natural fuel breaks. Oak and associated understory species were highly sensitive to relative humidity levels. These fuels contributed to fire spread only under the driest conditions.

Several fires in the southern Cascades burned normally, given the conditions and time of year. Many of these fires burned in areas with above normal loading due to snow and wind damage with total consumption of fuels less than 3 inches. Seventy percent of the 3 to 9 inch material was consumed along with about 10% of the 9 inch and larger fuels. Energy Release Component (ERC) was running near average levels for this time of year.

In northeastern Washington, most of the fires are occurring at lower elevations in mixed grass and pine. Those at elevations above 2200 feet in mixed conifer stands are remaining fairly small. Fires were typical of spring burns with little consumption of heavy fuels. Little if any torching or crowning was observed. At elevations below 2200 feet, fires in grass and bitterbrush were burning with 4 to 6 foot flame lengths.



In northeastern Oregon, dry lightning storms have resulted in numerous small forest fires and larger range fires, up to 150 acres, in cured grasses at lower elevations. Higher elevation fires (4500 feet and higher) are beginning to present more difficulty as larger fuels dry under the hot, dry weather conditions. Conditions are similar to the 1996 fire season that started out wet but dried rapidly and turned into one of the more severe seasons.

Possible Future Situations and Implications

Expected Duration and Situation-Ending Criteria

Estimates of the duration of wildland fire activity were based on a review of daily precipitation probabilities and historical weather records. The probability of season-ending events was assessed through an analysis of historical weather records. The following sections describe these reviews and provide the basis for the later discussion regarding future scenarios.

Daily Precipitation Probabilities:

La Nina's effect on the Pacific Northwest's weather during August and September is expected to be small because it will still be in the developing stage. The outlook for August favors a little warmer and drier conditions than normal throughout Washington and Oregon. Strong high pressure aloft is forecast to remain over the Western States with a weak upper trough off the Pacific coast. This results in a southwesterly flow of air over the Region which is a favorable for episodes of dry lightning and/or gusty winds as weak disturbances move in from the Pacific. The immediate coastline may see a little more marine air than usual but any marine intrusions into the interior valleys should be short-lived.

September will likely remain warmer and drier than normal, although long-term precipitation records indicate a short period of rain around the middle of the month. The threat of dry lightning will be on the decrease and should not be a factor after the middle of the month. However, the probability of East Wind events (strong foehn winds from the crest of the Cascades to the Coast) will increase. Precipitation rankings during La Nina events (Climate Prediction Center) suggests August and September will be "somewhat drier" than normal (Figure 14).

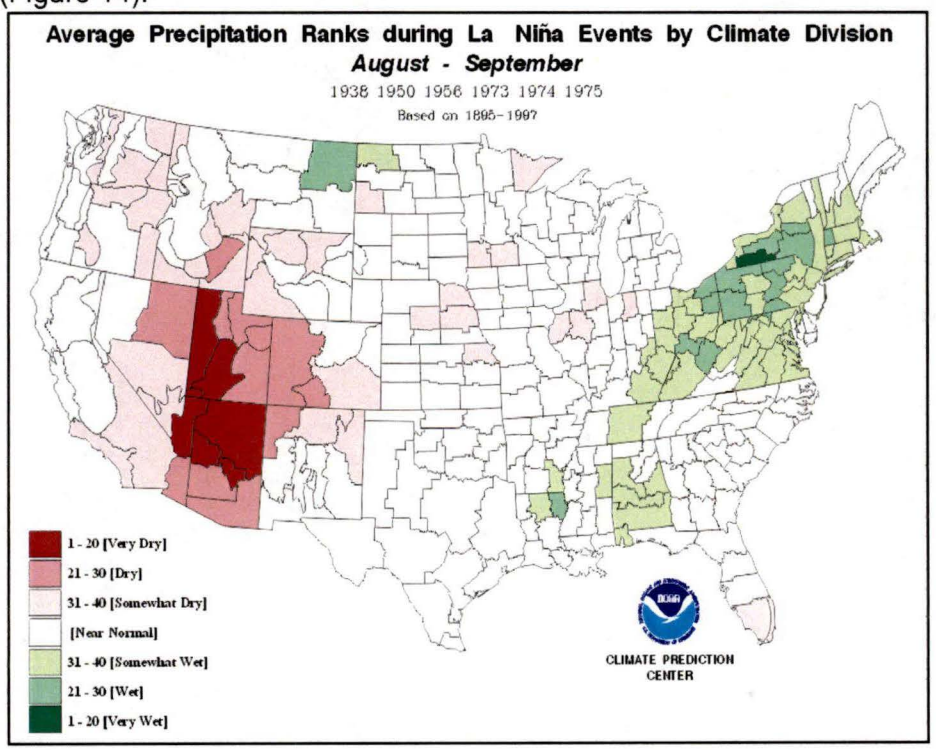
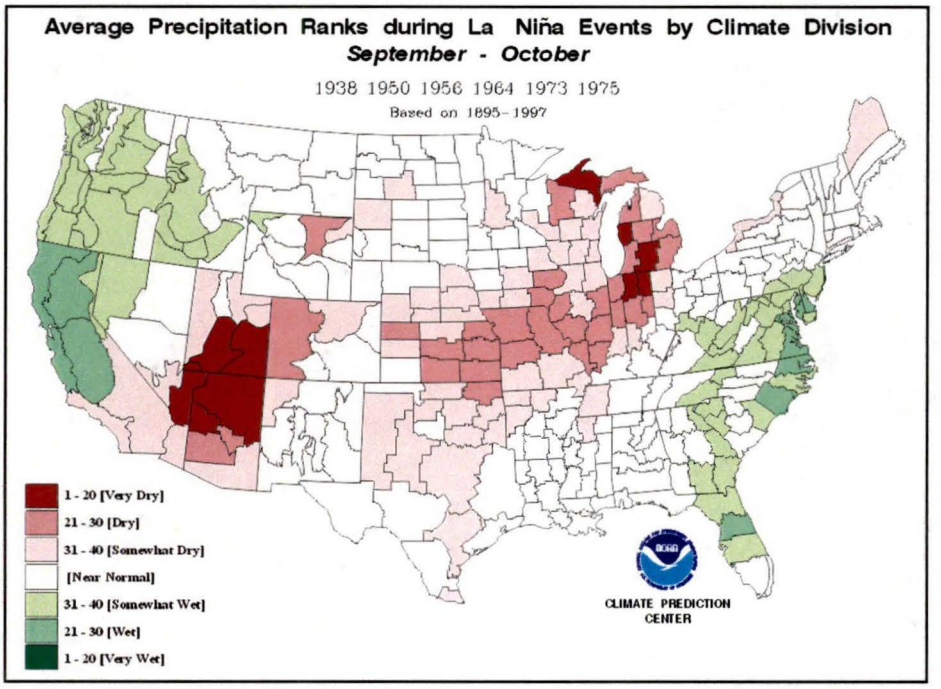

Average Precipitation Ranks during La Niña Events by Climate Division
August - September
1938 1950 1956 1973 1974 1975
Based on 1895-1997
1 - 20 [Very Dry]
21 - 30 [Dry]
31 - 40 [Somewhat Dry]
[Near Normal]
31 - 40 [Somewhat Wet]
21 - 30 [Wet]
1 - 20 [Very Wet]
CLIMATE PREDICTION CENTER

Figure 14. Average precipitation ranks during La Nina events, August - September.

October has the potential to be very dry and warm with more than the usual number of East Wind episodes. The long range forecast, produced by the National Center for Environmental Prediction (NCEP), indicates this La Nina may develop into a strong event during the late fall and winter, similar to the La Nina in 1988-1989. October of 1988 was one of the driest on record in the Pacific Northwest with most areas receiving just 10% or less of the normal rainfall during the month. There were also an unusually large number of strong East Winds. Precipitation patterns can vary widely from one La Nina to the next, some wet and some dry. Average precipitation rankings during La Nina years indicate somewhat wetter than normal conditions from September through October (Figure 15).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September - October
1938 1950 1956 1964 1973 1975
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1 - 20 [Very Dry]
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[Near Normal]
31 - 40 [Somewhat Wet]
21 - 30 [Wet]
1 - 20 [Very Wet]
CLIMATE PREDICTION CENTER

Figure 15. Average precipitation ranks during La Nina events, September - October.

One can conclude from Figures 14 and 15 that most of this precipitation will fall sometime in October. Long term precipitation probabilities indicate the probability of .50 inches of rain increases very rapidly in western Washington in late September and in early October in northwest Oregon. The probability of .25 inches of rain shows a marked increase east of the Cascades and in southwest Oregon in mid October (Figs 16 - 19). Factoring in 1988, there is a definite possibility this fall may see a delay in significant rains until late October or the first part of November.

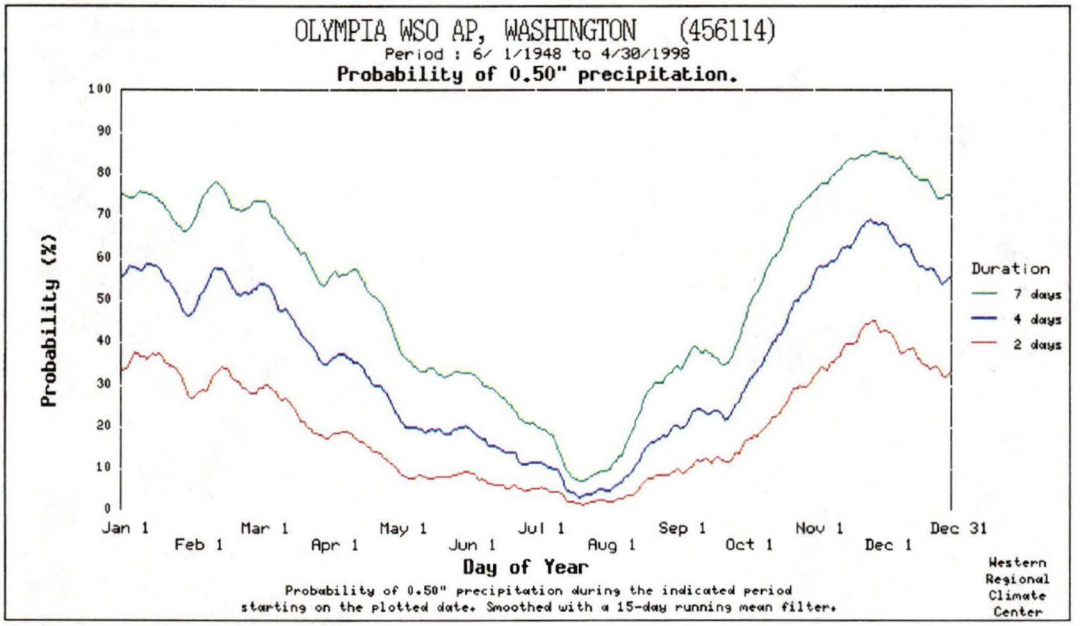

Figure 16. Probability of 0.5 inches of rain over a 2, 4, 7 day period for Olympia, WA.

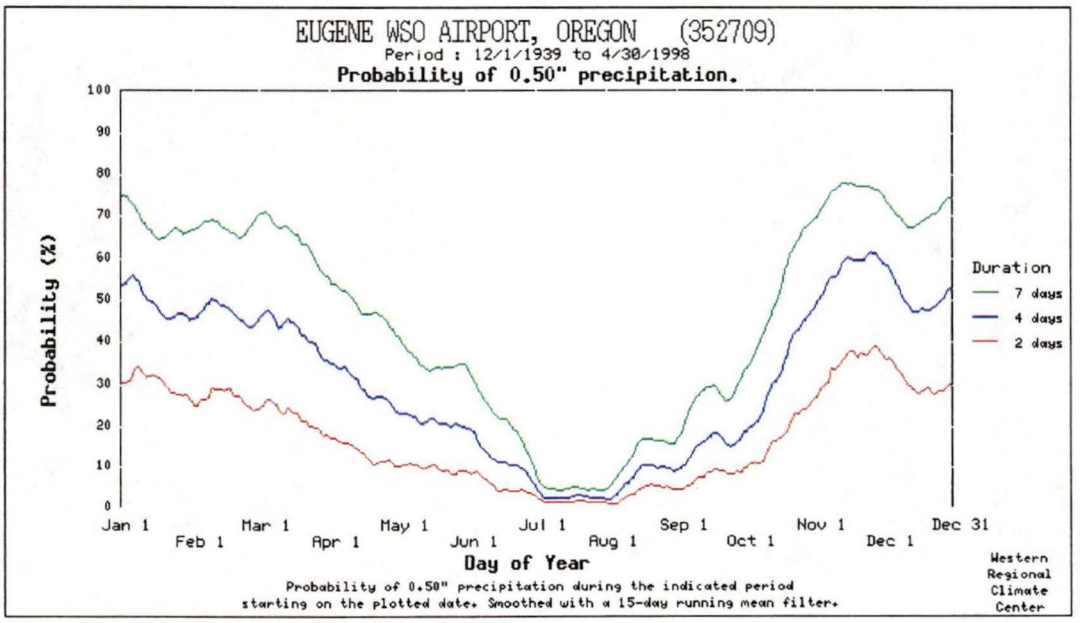

Figure 17. Probability of 0.5 inches of rain over a 2, 4, 7 day period for Eugene, OR.

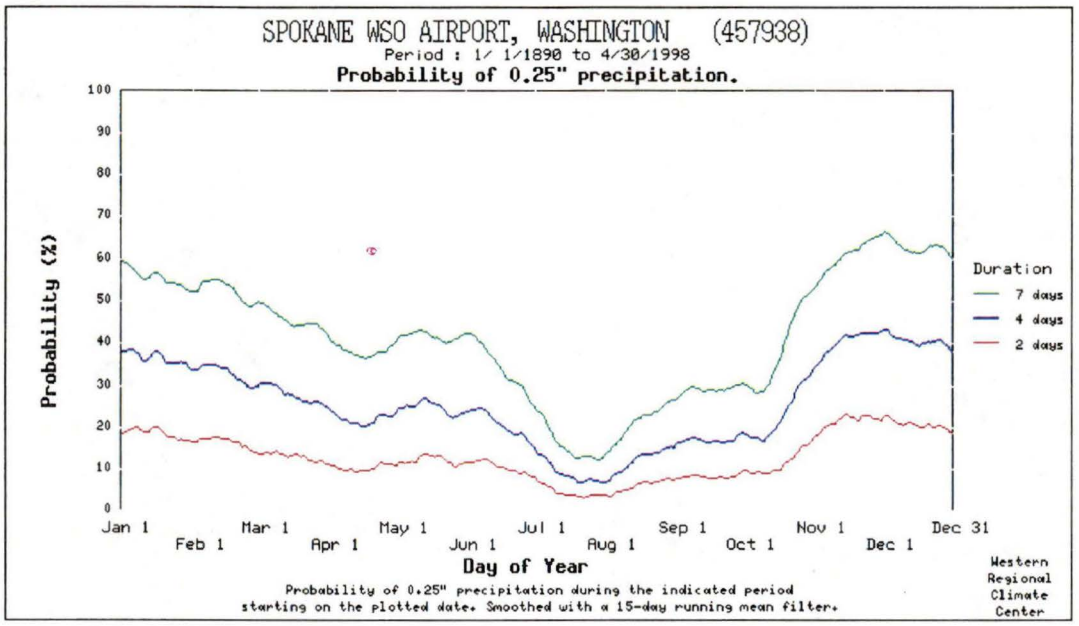

Figure 18. Probability of 0.25 inches of rain over a 2, 4, 7 day period for Spokane, WA.

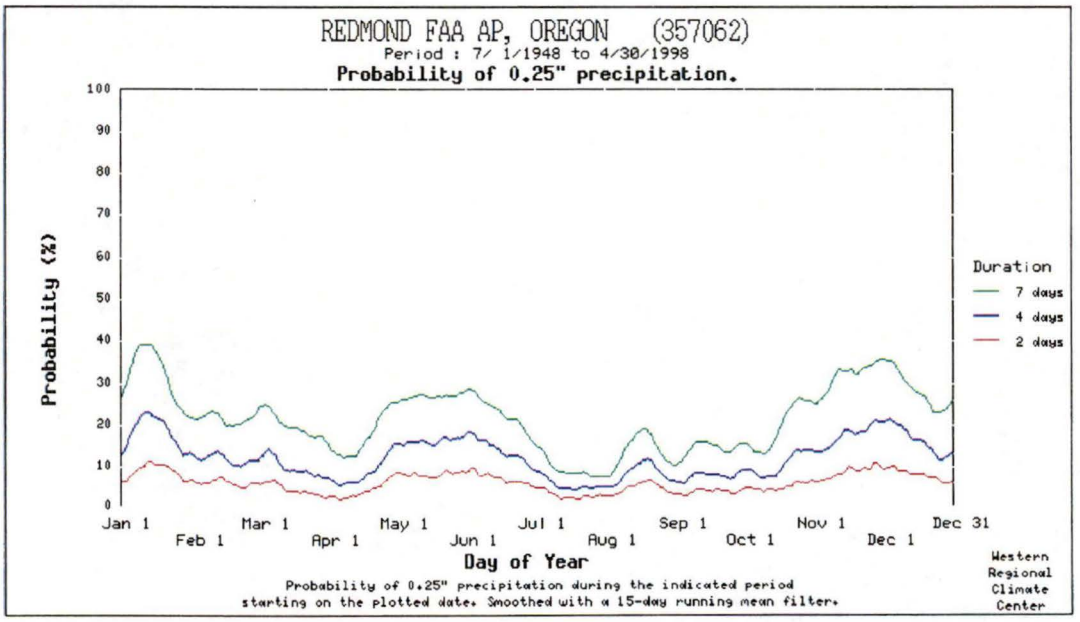

Figure 19. Probability of 0.25 inches of rain over a 2, 4, 7 day period for Redmond, OR.

La Nina usually peaks during the winter and thus has much more of a pronounced effect on winter weather. The long range outlook for the coming winter indicates cooler and wetter than normal conditions throughout the Pacific Northwest (Figure 20) and drier than normal weather across the southern states from southern California to Florida. Western Washington and western Oregon have the potential for very wet weather this winter because the jet stream is directed toward the Washington and Oregon coasts.

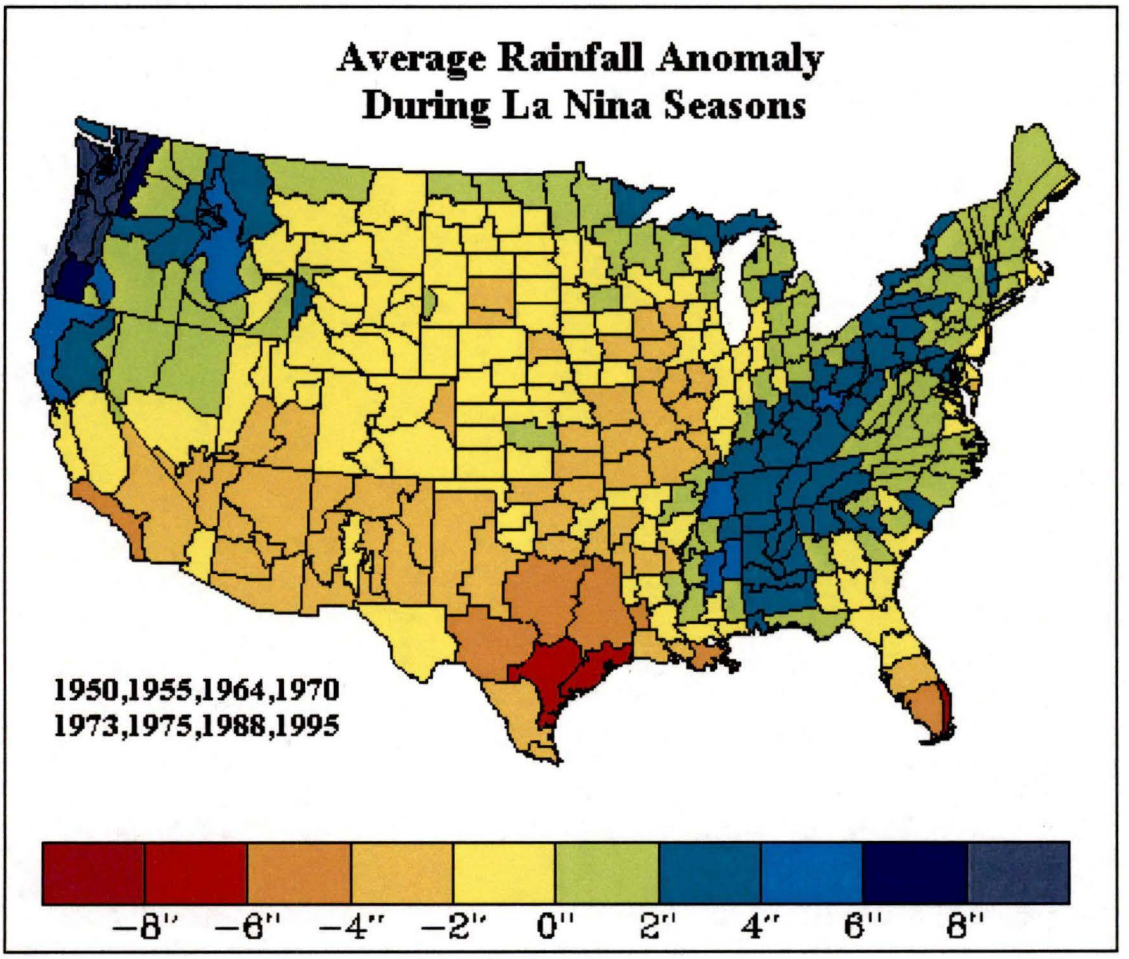

Figure 20. Average rainfall anomaly during La Nina Seasons.

Analysis of Season Ending Events:

Analysis of the history of season ending events can illustrate the probabilities associated with fire season duration. A season ending date is that point in time when fires no longer spread more than one burning period. Season ending dates were determined in 1994 for the seven preparedness zones comprising Oregon and Washington.

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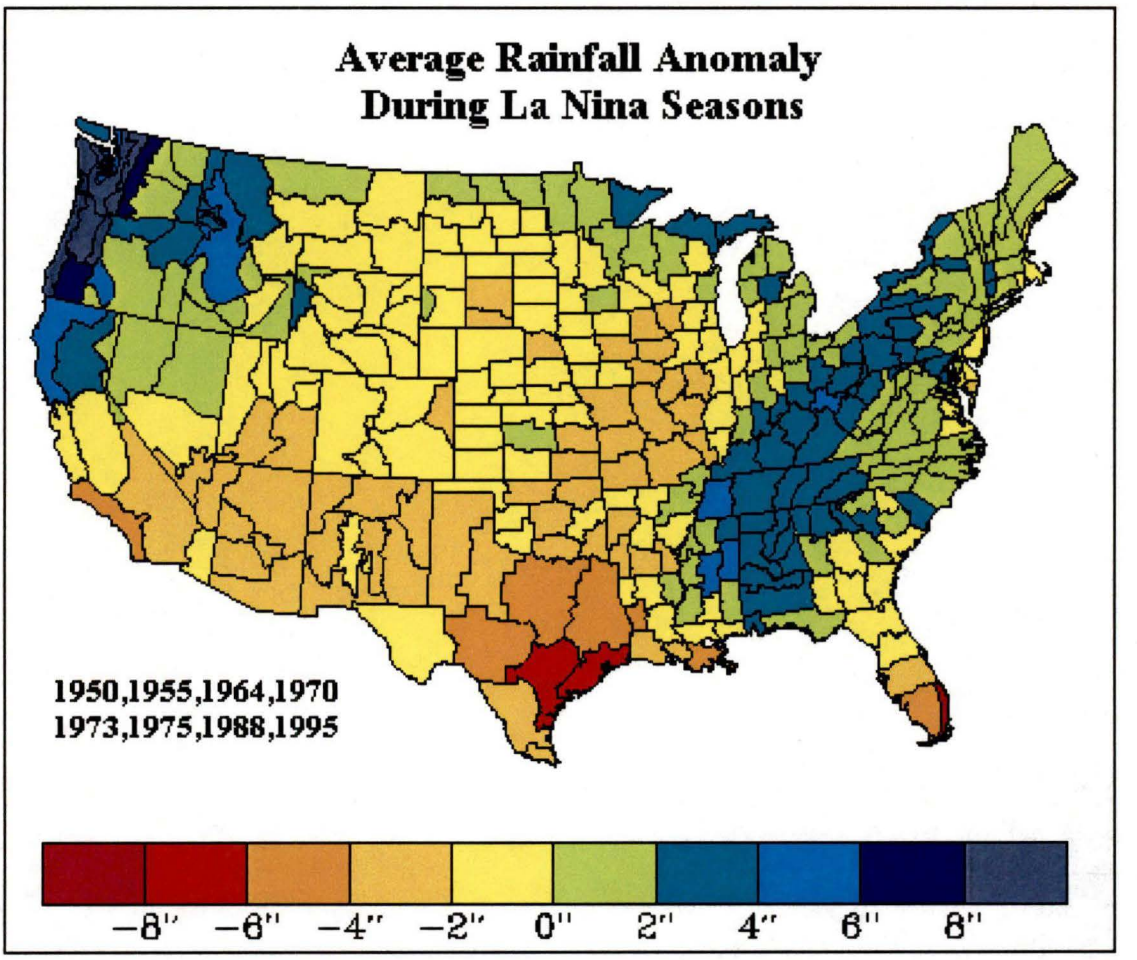

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Analysis of the history of season ending events can illustrate the probabilities associated with fire season duration. A season ending date is that point in time when fires no longer spread more than one burning period. Season ending dates were determined in 1994 for the seven preparedness zones comprising Oregon and Washington.

Criteria for the season ending events varied by preparedness zones.

Eastern zones (B, D, E, and G): 0.25 inches or more of precipitation within a period of three days.

Western zones (A, C, and F): 0.50 inches or more of precipitation within a period of five days.

These season ending dates were used with the Rare Event Risk Assessment Process (RERAP) (Wittala and Carlton, 1993) to create cumulative probability curves. The tables below display event dates and the cumulative probabilities:

Weather records from 1969 to 1994 from a weather station representing each zone were utilized. Table 3, from the 1994 analysis, displays by preparedness zone, the dates and corresponding probabilities a season ending event is likely to occur based on historic weather.

Table 3. Season ending dates and probabilities by preparedness zones.

Prob %	Preparedness Zones and Representative Weather Station						
	Zone A (Western WA) Stampede	Zone B (Eastern WA) Lane Creek	Zone C (Northwest OR) Boulder Creek	Zone D (Central OR) Red Box	Zone E (Northeast OR) Pendleton	Zone F (Southwest OR) Quail	Zone G (Southeseast OR) Rock Creek
10	09/08	09/12	09/08	09/05	09/13	09/30	09/05
20	09/18	09/20	09/18	09/15	09/24	10/09	09/15
30	09/25	09/25	09/25	09/22	10/02	10/15	09/22
40	09/30	09/29	09/30	09/28	10/08	10/19	09/28
50	10/05	10/03	10/05	10/03	10/13	10/23	10/03
60	10/10	10/07	10/10	10/08	10/18	10/27	10/08
70	10/15	10/13	10/15	10/14	10/24	10/31	10/14
80	10/21	10/16	10/21	10/20	10/30	11/04	10/20
90	10/29	10/22	10/29	10/28	11/07	11/10	10/28

September is the earliest that any zone experiences its season ending event. The latest season ending events occur in late October. If the La Nina weather pattern does result in a drier than normal fall, season ending event dates may occur later across all preparedness zones.

Scenarios for the Future:

Projections of three possible scenarios were developed based on review and analysis of historical weather, fire activity information, and comparison with current-year trends and fire activity. The scenarios include a low level of fire activity (best-case scenario), an average level of fire activity (intermediate case situation), and a high level of fire activity (worst-case situation).

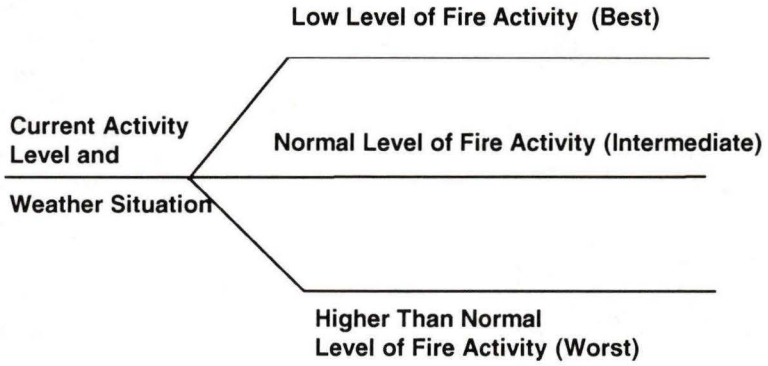
Low Level of Fire Activity (Best)
Current Activity Level and Weather Situation
Normal Level of Fire Activity (Intermediate)
Higher Than Normal Level of Fire Activity (Worst)

Figure 21. Three potential fire season activity scenarios for the Northwest area.

The Worst Case Scenario:

The National Center for Environmental Prediction's (NCEP) long range forecast indicates this could be one of the stronger La Nina events, similar to the one in 1988-1989. Except for some spotty rain the third week in September, the fall of 1988 was extremely dry. October set records for dryness with less than 10% of normal rainfall throughout Washington and Oregon. It wasn't until the first part of November when significant amounts of rain and snow fell. A similar dry fall this year would represent a worst case scenario extending the fire season into early November. In this case, August would remain very warm and dry with an above normal amount of dry lightning. Occasional dry cold fronts with strong wind could result in large "wind driven" fires. September and October would remain much drier and warmer then normal. Frequent East Wind episodes would occur from the crest of the Cascades to the Coast. Fire activity would continue into early November, especially in southwest Oregon. The probability of this scenario is greater than the best case but less than the intermediate scenario.

The Intermediate Case Scenario:

The intermediate scenario reflects more moderate conditions. August would still be warmer and drier than normal. However, normal amounts of dry lightning and dry cold front events would occur. Spotty light rain is possible in September but will not be significant. September and October would remain warmer and drier than usual with occasional periods of East Winds. **This scenario has the greatest likelihood of occurrence.**

The Best Case Scenario:

The best case scenario suggests a more normal end to the fire season in the Pacific Northwest. Precipitation records during past La Nina years and long range forecasts suggest this scenario has a low probability of occurrence. In this scenario, there would be minimal cases of dry lightning, dry cold front winds and East Winds. A period of significant rain would fall in September, which would slow the fire season. "Season-ending" rain would occur in late September in western Washington and in early to mid October elsewhere across the region.

Implications:

The following tables summarize the scenarios and the potential impacts of each.

Table 4. Weather factors related to potential fire activity scenarios in the Northwest Area for late summer - early fall, 1998.

Scenario	Temp.	Relative Humidity	Precipitation	Probability of Dry Lightning	Dry Cold Front	Probability of Extended Drying Periods	East Winds	Haines 5 and 6 days
Best	Normal	Normal	Normal	Minimal	Infrequent	Low	Minimal	Infrequent
Intermediate	High	Low	Light and localized	Normal	Occasional	High	Occasional	Occasional
Worst	High	Low – Poor Nighttime Recover	Insignificant	Higher Than Normal	Occasional	High	Frequent	Occasional

Table 5. Regional and national implications of potential fire activity scenarios in the Northwest Area for late summer - early fall, 1998.

Scenario	Large Fire Activity	Resource Demands	Threats to Life and Property	Fire Behavior	Fire Season Duration
Best	High	Local plus other within-region resources	Infrequent	Normal	Mid-September
Intermediate	Initial attack plus occasional large fires	Local plus regional and national resources	Occasional	Elevated spread rates and intensities, occasionally crown fires	Mid-October
Worst	Initial attack plus frequent large fires (many with long-duration)	Local plus regional and national resources, severe shortages	Recurrent	Extreme spread rates and intensities, sustained and extensive crown fire	Late October, early November

Summary

The fire situation in the Northwest Area for the remainder of 1998 has the potential to escalate to above average occurrence with elevated fire behavior that may persist through October. Late spring rains promoted growth of fine fuels in the southern portion of the geographic area. This growth resulted in fuel loadings up to three times greater than normal. Weather projections indicate warmer and drier conditions through October. Although lightning activity will decrease in September, the probability of East Winds will increase. Some parallels to the 1996 fire season can be made, especially in terms of the status of vegetative curing in Washington (derived from greenness maps). Warmer and drier weather in combination with elevated fuel loads could promote large fires well into the middle of the fall.

By early July, one of the strongest El Nino events this century gave way to the beginning of La Nina. La Nina is the opposite of El Nino and is characterized by unusually cold ocean temperatures from the date line eastward to the South American coast. The main effect during the remainder of the summer will be a little warmer and drier weather than normal. The weather pattern will also be favorable for more than the usual dry lightning and strong wind events. Weather records from past strong La Nina years suggest a drier than normal fall and more than the usual number of East Wind cases.

Fire danger indices vary within the geographic area. Although the eastern portion of the area seems to have the highest indices at this time, the western areas should also be monitored. If dry weather persists, all areas could rapidly progress into a late and severe fire season.

This assessment revealed the following conditions:

- continued dry weather will result in curing of the bumper herbaceous crop, especially in east side preparedness zones,
- large fuels will begin to contribute to fire growth,
- fire spread rates and intensity will increase potentially resulting in more large fires,
- fire season activity similar to 1987, 1994, or 1996 is possible, given the current conditions,
- problematic fire activity could persist for three to four weeks longer than normal.

As the fire season progresses several indicators may be useful to anticipate the development of a critical fire situation. A set of criteria useful for this purpose is offered in the following list.

- lower than normal September/October moisture,
- fire danger as indicated by fuel moistures and Energy Release Component climb steeply,
- prolonged drying periods, especially if followed by relatively dry lightning,

- drying sufficient to promote large fire growth in high elevation forests,
- greenness imagery indicates widespread and/or rapid curing,
- ignitions sufficient in number to overwhelm initial attack capability,
- fires that spread fast enough to escape initial attack,
- low initial attack or reinforcement resource availability,
- large number of backcountry fires with poor accessibility.

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